

APPLICATION
FOR
UNITED STATES LETTERS PATENT

TITLE: VEHICULAR HEADLAMP

APPLICANTS: Seiichiro YAGI

22511

PATENT TRADEMARK OFFICE

“EXPRESS MAIL” Mailing Label Number: EV370764944US
Date of Deposit: February 25, 2004

VEHICULAR HEADLAMP

The present application claims priority from a Japanese Patent Application No. 2003-059444 filed on March 6, 2003, the contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

Field of the Invention:

10 The present invention relates to a vehicular headlamp. More particularly, the present invention relates to a vehicular headlamp used for a vehicle.

Related Art:

15 Recently, the detection of obstacles in front of a vehicle such as an automobile or at the shoulder of the road by emitting infrared light has been discussed. In this case, by an infrared ray projector mounted on the vehicle emits the infrared light. In addition, a vehicular lamp including but not limited to, for
20 example, a regular headlamp, a fog lamp and a cornering lamp of automobiles, motorcycles, trains and the like, a having a function of the infrared ray projector has been known as disclosed, for example, in Japanese Utility Model Application Publication No. 6-10880. In the light source of this vehicular lamp, a
25 suitable number of infrared light LEDs are being mixed in addition to a visible light LED for emitting the light of a lamp light color.

30 The light source emitting the infrared light, however, might further emit red light besides the infrared light. In this case, the infrared ray projector may also emit the red light accompanying the emission of the infrared light.

Here, since the color of the red light is used as the lamp light color of, e.g. a brake lamp of a vehicle, the improper emission of the red light might be undesirable. Consequently, the infrared light might not be emitted properly in the prior art.

SUMMARY OF THE INVENTION

Therefore, it is an object of the present invention to provide a vehicular headlamp, which is capable of overcoming the above drawbacks accompanying the conventional art. The above and other objects can be achieved by combinations described in the independent claims. The dependent claims define further advantageous and exemplary combinations of the present invention.

According to the first aspect of the present invention, a vehicular headlamp used for a vehicle, includes an infrared light source for generating red light and infrared light, a visible light source for generating visible light, of which the wavelength is different from that of the red light, an optical system for emitting the red light and visible light towards a substantially same emission area in front of the vehicle and a lighting circuit for turning on the infrared light and visible light sources with the strength in order that the chromaticity in the emission area based on the red light and visible light can correspond to white light within a predetermined range in chromaticity coordinates. The infrared light source may include a semiconductor infrared light emitting element for generating the red light and infrared light, and the visible light source may include a semiconductor white light emitting source for generating the white light.

The lighting circuit may turn on the infrared light and visible light sources with the strength in order that the X-coordinate of the chromaticity in the emission area can be within a range of 0.450 to 0.500 and the Y-coordinate thereof
5 can be within a range of 0.380 to 0.440.

The lighting circuit may turn off the infrared light source, if the speed of the vehicle is lower than a predetermined level.

The vehicular lamp to which the present invention may be applied to includes, but not limited to, a regular headlamp,
10 a fog lamp and a cornering lamp of automobiles, motorcycles, trains and the like.

The summary of the invention does not necessarily describe all necessary features of the present invention. The present invention may also be a sub-combination of the features described
15 above. The above and other features and advantages of the present invention will become more apparent from the following description of the embodiments taken in conjunction with the accompanying drawings.

20 BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows an example of the configuration of a vehicular lamp 20 according to an exemplary embodiment of the present invention.

25 Fig. 2 shows an example of the configuration of an infrared light source unit 100.

Fig. 3 shows an example of the configuration of a white light source unit 200.

Fig. 4 shows an example of a light distribution pattern
30 400.

Fig. 5 shows chromaticity coordinates depicting the

chromaticity of an infrared light pattern 404.

Fig. 6 is a vertically cross-sectional view BB of an infrared light source unit 100.

Fig. 7 is a horizontally cross-sectional view AA of an
5 infrared light source unit 100.

DETAILED DESCRIPTION OF THE INVENTION

The invention will now be described based on the preferred
10 embodiments, which do not intend to limit the scope of the present invention, but exemplify the invention. All of the features and the combinations thereof described in the embodiment are not necessarily essential to the invention.

Fig. 1 shows an example of the configuration of a vehicular
15 lamp 20 according to an exemplary embodiment of the present invention. It is the object of the present embodiment to provide a vehicular lamp 20 for properly emitting the infrared light forward from a vehicle.

In this embodiment, the vehicular lamp 20, which is a
20 vehicular headlamp for low and high beam emissions attached to a vehicle such as an automobile, includes a plurality of infrared light source units 100, a plurality of white light source units 200 and 250, and a plurality of fog lamp light source units 300 in a lamp chamber formed of a transparent cover 22 and a lamp
25 body 24. The vehicular lamp 20 contains the light source units 100, 200, 250 and 300 in the lamp chamber in order that the light axis when the vehicular lamp 20 is attached to a vehicle body can be inclined downwards by 0.3 to 0.6 degrees against the front and back direction of the vehicle.

30 In addition, the vehicular lamp 20 forms a predetermined light distribution pattern based on the light emitted by the

light source units 100, 200, 250 and 300 forward from a vehicle. In this case, the infrared light source units 100 emit the infrared light forward from the vehicle. The white light source units 200 and 250 emit the white light forward from the vehicle. And, 5 the fog lamp light source units 300 emit the yellow light forward from the vehicle. Each of the light source units 100, 200, 250 and 300 generates the light corresponding to the power received from a lighting circuit 112 provided in the vehicular lamp 20.

Furthermore, in this embodiment, the white light source 10 units 200 adjacent to the infrared light source units 100 can be used to lessen the red light emitted by the infrared light source units 100 accompanying the emission of the infrared light. In addition, the other white light source units 250 are used to form the light distribution patterns for the low and high 15 beams. The plurality of white light source unit 250 may have the same or similar light distribution characteristics as or to each other or may have different light distribution characteristics from each other.

Fig. 2 shows an example of the configuration of the infrared 20 light source unit 100. The infrared light source unit 100 includes a bottom part 108, a translucent cover 106, an infrared light source 102, and a reflector 104.

The bottom part 108, which is a plate-like material, holds the infrared light source 102 on its upper surface. The 25 translucent cover 106, which is a translucent and transparent material for covering the front face of the infrared light source unit 100, passes through the light reflected by the reflector 104 forward from the infrared light source unit 100.

The infrared light source 102, which is a light emitting 30 diode module mounted on the bottom part 108, includes an infrared light LED 110 and a mold 114. The infrared light LED 110, which

is an example of a semiconductor light emitting element, generates the red light and the infrared light corresponding to the power received from the lighting circuit 112 disposed outside the infrared light source unit 100. The infrared light LED 110 may
5 generate near-infrared light of about 770nm to 1 μ m in wavelength as the infrared light.

The mold 114, which is a seal member formed of, e.g. translucent resin to cover the infrared light LED 110, passes through the red light and infrared light generated by the infrared
10 light source 102 outwards from the infrared light source 102. Accordingly, the infrared light source 102 generates the red light and the infrared light. Furthermore, the red light is, e.g. the visible light of about 630nm in wavelength, which occurs accompanying the generation of the near-infrared light.

15 Here in the present embodiment, the lighting circuit 112 is provided to the plurality of light source units 100, 200, 250 and 300 (cf. Fig. 1) in common. In another embodiment, the vehicular lamp 20 (cf. Fig. 1) may include lighting circuits 112 provided to each of the light source units 100, 200, 250
20 and 300 respectively. In this case, the lighting circuits 112 may be provided in lamp chambers corresponding to each of the light source units 100, 200, 250 and 300.

The reflector 104 having a shape like a part of, e.g. a parabolic face is provided extending from the back of the infrared
25 light source 102 towards the upper front thereof to cover the infrared light source 102. Due to this, the reflector 104 reflects the red light and the infrared light generated by the infrared light source 102 forward from the infrared light source 102. The reflector 104 reflects the red light and the infrared
30 light forward from the vehicle as substantially parallel rays.

In this embodiment, the infrared light source unit 100

has a function of an infrared ray projector for emitting the infrared light forward. Here, the automobile 10 (cf. Fig. 1) includes an infrared ray camera such as a CCD camera for detecting the infrared light so as to perform the detection of obstacles
5 in an invisible area, in front of the vehicle, or at the shoulder of the road.

Furthermore, the reflector 104 may have the optical center that is, e.g. the focus or the reference point in optical design near the infrared light source 102. In this case, the reflector
10 104 can reflect the red light and the infrared light generated by the infrared light source 102 highly accurately.

In addition, the reflector 104 may have a light distribution step to obtain the light distribution pattern of a predetermined boundary between bright and dark. In this case, the red light
15 and infrared light can be properly emitted towards the desired area.

Here, the light distribution step, which is a part of the reflector 104 sectioned to be shaped like a rectangle or diagonally slanted trapezoid, is formed of, e.g. a hyperbolic
20 and parabolic face that is set corresponding to the shape of the boundary between bright and dark of the light distribution pattern supposed to be formed at each position on the parabolic face. Here, the hyperbolic and parabolic face is the same as or similar to a curved face formed of parabolas whose
25 substantially vertical cross-section becomes wider towards the front of the infrared light source unit 100 and whose substantially horizontal cross-section becomes wider towards the back of the infrared light source unit 100.

Fig. 3 shows an example of the configuration of the white
30 light source unit 200. The white light source unit 200 includes a white light source 202, a bottom part 208, a translucent cover

206, and a reflector 204.

The white light source 202, which is a light emitting diode module mounted on the bottom part 208, includes a white light LED 210 and a mold 214. The white light LED 210, which is an
5 example of a semiconductor light emitting element, generates the white light that is an example of the visible light whose wavelength is different from that of the red light corresponding to the power received from the lighting circuit 112. In addition, the mold 214, which is a seal member formed of, e.g. translucent
10 resin to cover the white light LED 210, passes through the white light generated by the white light LED 210 outwards from the white light source 202. Accordingly, the white light source 202 generates the white light.

In this embodiment, the white light source unit 200 includes
15 a white light source 202 as an alternative to the infrared light source 102 (cf. Fig. 2), and has the same or similar function as or to the infrared light source unit 100 (cf. Fig. 2). Each of the bottom part 208, the translucent cover 206 and the reflector 204 has the same or similar function as or to the bottom part
20 108, the translucent cover 106 and the reflector 104 respectively. Accordingly, the white light source unit 200 emits the white light towards approximately the same area as that to which the infrared light source unit 100 emits the red light and the infrared light. In this case, the reflector 104 (cf. Fig. 2) and the
25 reflector 204 have a function of an optical system for emitting the red light and the white light towards approximately the same area in front of the automobile 10.

Here, when the red light is emitted forward from the automobile 10 (cf. Fig. 1), another automobile facing the
30 automobile might mistake this red light for the red light of, e.g. a brake lamp or tail lamp. Accordingly, the emission of

the red light from a vehicle is undesirable in terms of security and also regulated by laws. In the present embodiment, however, the white light source unit 200 emits the white light substantially added to the infrared light emitted by the infrared light source unit 100. In this case, the chromaticity emitted by the vehicular lamp 20 (cf. Fig. 1) is adjusted by mixing the red light with the white light, so that the red light can be properly lessened in front of the automobile 10. Therefore, in the present invention, although the red light is generated by the infrared light source 102 accompanying the infrared light, the infrared light can be emitted forward from the vehicle securely and properly.

Furthermore, when the red light generated by the infrared light source 102 is reduced by using, e.g. a translucent film such as a filter, this translucent film might undesirably reduce the infrared light whose wavelength is close to the red light significantly. In this embodiment, however, the chromaticity of the light is adjusted by further adding other visible light to the red light, so that the red light can be properly lessened without reducing the infrared light. Particularly, if using a semiconductor light emitting element having a predetermined peak wavelength such as a light emitting diode as a light source for the infrared light and other visible light supposed to be added thereto, it is possible to properly combine the red light and the other visible light.

In another embodiment, the white light source unit 200 may further emit other visible light in addition to the white light. For example, the white light source unit 200 may further emit the light of cyan color which is the complementary color of the red color. In this case, the red light can be further properly lessened. The white light source unit 200 may further

include a light source for generating the light of cyan color.

And in further another embodiment, the vehicular lamp 20 may include a light source unit for emitting the visible light other than the white light such as green as an alternative to the white light source unit 200. In this case, the light source unit includes a light source for generating the visible light, and thereby lessens the red light emitted by the infrared light source unit 100. The light source unit may emit, e.g. the light of cyan color as this visible light.

Fig. 4 shows an example of the light distribution pattern 400 formed by the vehicular lamp 20. The light distribution pattern 400 is formed on a vertically virtual screen disposed 25 meters forward from a vehicular lamp 20. The vehicular lamp 20 forms a low beam pattern 402 and an infrared light pattern 404 as an example of the light distribution pattern 400.

The white light source units 250 form the low beam pattern 402 having a cut line which is the boundary between bright and dark in the horizontal and predetermined inclined directions by emitting the white light forward. The white light source units 250 projects the edge shape of a shade which is a light shielding member provided in the white light source units 250 forward in order to form the cut line.

In addition, the infrared light source units 100 and the white light source units 200 form the infrared light pattern 404 at a predetermined emission area surrounding the low beam pattern 402. In this embodiment, the infrared light source units 100 emit the red light and the infrared light towards the emission area. And, the white light source units 200 emit the white light of enough strength to lessen the red light towards the same emission area. In this case, the white light source units 200 may emit the white light weaker than that of the white light

source units 250.

In this case, the lighting circuit 112 (cf. Figs. 2 and 3) turns on the infrared light source 102 (cf. Fig. 2) and the white light source 202 (cf. Fig. 3) with particular strength
5 in order that the chromaticity in the emission area based on the red light and the white light can correspond to the white light within a predetermined range in the chromaticity coordinates. Accordingly, in the present embodiment, the red light can be properly removed or reduced in front of the automobile
10 10. In addition, the infrared light can be properly emitted.

Here, if the speed of the automobile 10 (cf. Fig. 1) is lower than a predetermined level such that the automobile 10 is stopped, the lighting circuit 112 turns off the infrared light source 102 by stopping supplying power to the infrared light
15 source 102. In this case, the infrared light can be prevented from being repeatedly emitted towards, e.g. the eyes of a pedestrian. In addition, due to this, the infrared light can be emitted further securely. And, the vehicular lamp 20 may form a fog lamp pattern based on the yellow light generated by
20 the fog lamp light source units 300 as a part of the light distribution pattern 400.

Fig. 5 shows the chromaticity coordinates depicting the chromaticity of the infrared light pattern 404. The points 502 and 504 indicate the chromaticity of the emission area formed
25 by the infrared light pattern 404 in both cases that the white light source units 200 are turned on or not respectively. When only the infrared light source units 100 are turned on with the white light source units 200 turned off, the infrared light pattern 404 corresponding to the point 502 close to red is formed
30 on the basis of the red light emitted by the infrared light source units 100.

On the other hand, when the infrared light source units 100 and the white light source units 200 are turned on altogether, the white light source units 200 lessens the red light caused by the infrared light source units 100 by the white light.

5 Accordingly, the infrared light pattern 404 is formed by the white light of the chromaticity corresponding to the point 504 based on the red light and white light emitted by the infrared light source units 100 and the white light source units 200. In the present embodiment, the X-coordinate of the point 504

10 is 0.484, and the Y-coordinate is 0.419.

The lighting circuit unit 112 turns on the infrared light source 102 and the white light source 202 with the strength in order that the X-coordinate of the chromaticity in the emission area can be 0.450 to 0.500 and the Y-coordinate thereof can be

15 0.380 to 0.440. In this case, since the light of red or amber color is not emitted forward from the automobile 10, another automobile facing the automobile 10 can be prevented from mistaking the vehicular lamp 20 for a brake lamp or tail lamp.

In addition, humans feel incompatibility to sense colors

20 in their eyes right after their eyes receive the red light, and thus pedestrians might be in danger if the red light is emitted towards their eyes. In the present embodiment, however, the chromaticity of the infrared light pattern 404 is adjusted, and thereby the red light can be prevented from being emitted towards

25 the eyes of pedestrians. Accordingly, high security can be guaranteed. According to the present embodiment, it is possible to form the infrared light pattern 404 of proper chromaticity.

Figs. 6 and 7 show another example of the configuration of the infrared light source unit 100. Fig. 6 is a vertically

30 cross-sectional view BB of the infrared light source unit 100. Fig. 7 is a horizontally cross-sectional view AA of the infrared

light source unit 100. In this embodiment, the infrared light source 102 further includes a white light LED 210. The white light LED 210 is arranged being adjacent to the infrared light LED 110 to have a space of less than or equal to 0.2mm therebetween.

5 The surfaces of the infrared light LED 110 and the white light LED 210 may be about 1mm in size. And, in the present embodiment, the mold 114 seals the infrared light LED 110 and the white light LED 210 integrally.

In this case, the infrared light source 102 further has
10 a function of the white light source for generating the white light. In addition, the infrared light LED 110 and the white light LED 210 are arranged being adjacent to each other, and thereby the reflector 104 has a function of an optical system for emitting the red light and the white light towards
15 substantially the same emission area in front of the automobile 10 (cf. Fig. 1). In this case, the white light LED 210 lessens the red light generated by the infrared light LED 110 by the generated white light.

Accordingly, also in the present embodiment, the red light
20 accompanying the emission of the infrared light can be properly lessened. According to the present embodiment, the infrared light can be emitted securely and properly. Furthermore, except the points mentioned above, the configuration in relation to Figs. 6 and 7 given the same symbols as those in Figs. 2 and
25 3 will not be described because it has the same function as that in Figs. 2 and 3.

In addition, in another embodiment, the infrared light LED 110 and the white light LED 210 may be sealed by different molds respectively. In this case, the infrared light source
30 units 100 may include a plurality of light sources each of which includes the infrared light LED 110 and the white light LED 210.

As is obvious from the description above, according to the present invention, it is possible to emit the infrared light properly.

Although the present invention has been described by way
5 of exemplary embodiments, it should be understood that those skilled in the art might make many changes and substitutions without departing from the spirit and the scope of the present invention which is defined only by the appended claims. For example, the vehicular lamp to which the present invention may
10 be applied to includes, but not limited to, a regular headlamp, a fog lamp and a cornering lamp of automobiles, motorcycles, trains and the like.